BIOGRAPHICAL INFORMATION

Tom J. Huras
Partner
ExtenSys Inc.

Specific Responsibilities

Co-founded ExtenSys in 1993. Responsible for technical leadership on client projects for the acquisition and implementation of Outage Management Systems (OMS). Tom's expertise includes specifying and building the interface between GIS and OMS, and, more generally, project planning, system implementation and software development. His interests are in the use of GIS technology for real-time systems and the use of agile techniques for projects.

Past Experience

Prior to forming ExtenSys, Tom worked for over 12 years for CGI/Gellman,Hayward on a variety of projects such as software development of real-time industrial systems, specification of a plant display system for a nuclear power station, and product development of a GIS. In the early 1990's Tom worked on the North York Hydro project that was one of the first instances of a product-based distribution management system.

Educational Information

B.A.Sc. – Systems Design Engineering, University of Waterloo

Professional Memberships

GITA
Professional Engineers Ontario
Ontario Society of Professional Engineers

BIOGRAPHICAL INFORMATION

Michael E. Ashurst
Distribution Project Engineer
PEPCo

Specific Responsibilities

Joined PEPCo in 1974. My responsibilities encompass engineering support of day-to-day Distribution System Operations, Restoration Analysis and Technical Consulting of computer-based applications.

Past Experience

Over the past 30 years I have progressed from Drafting technician to Electric System Planner to System Operations Project Engineer. I brought CADD system implementations into the planning and analysis aspects at PEPCo. I expanded CADD capabilities to support electric connectivity model design for ABB-CADPAD and CADPAW systems.

I developed an automated web-based outage mapping system for Intranet and Internet usage. This web-based information and mapping system included both dynamic depiction of outage complaints and static area service maps with customer data. With the increased desire of automated information systems, I became the Technical Engineering Lead for initiating the corporate ESRI – GIS schema based upon existing Microstation feeder maps and corporate data while developing the CES-OMS electric connectivity model.

Currently, I am assisting other areas in the use of data from these new systems while exploring additional GIS based initiatives.

Educational Information

B.S.E. – Electronics Technology, Capitol College, Laurel, MD

Professional Memberships

GITA
Electric Power Research Institute
Institute of Electrical & Electronics Engineering, Power Engineering Society, Standards

BIOGRAPHICAL INFORMATION

Parag A. Parikh
Technical Product Manager
CES International

Specific Responsibilities

Joined CES in 2002. Responsible for product strategy, new product definition, product release content, and product packaging for paging and notification product MyCentricity, Data Modeling and Validation tools and standards product interfaces. Working closely with CES professional services group to define standard data modeling methods and integration with various GIS packages.

Past Experience

Prior to joining CES, Parag had over 11 years of experiences in various engineering, market research and GIS software design and development position with Intergraph Corporation, Southwest Technology Development Institute, Gujarat Electricity Board and Scientific Analyzers of Marketing Information & Research. His experience at Intergraph Utilities included technical team leader of software development team to implement GIS and AM/FM projects and enterprise application integration for various electric utilities in the North America.

Educational Information

B.S. – Electrical Engineering, Birla Engineering College, Sardar Patel University India
M.S. – Electrical Engineering, Electric Utility Management Program, New Mexico State University

Professional Memberships

GITA
GITA Southeast Chapter Board Member
Institute of Electrical & Electronics Engineers

INTEGRATING BEST OF BREED GIS AND OMS: IS A STANDARD INTERFACE POSSIBLE?

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ABSTRACT

A GIS provides more value to an electrical distribution utility when it is integrated with an Outage Management System (OMS). OMS can achieve many business benefits provided it is periodically supplied with quality, timely data. The OMS relies on a topological model of the electrical network provided by the GIS network model. Do GIS and OMS products from the same vendor really come pre-integrated? So how do you integrate best-of-breed products? A standard interface is desirable, but is it possible?

This paper discusses:

- The requirements on a GIS:OMS interface: What should the interface do? Does it impose changes on the GIS? Feeder versus landbase extraction. How does it fit into the workflow?
- Elements of the interface: GIS extract tool, model transformation, OMS load tool, and intermediate file formats.
- Performance considerations due to the large volume of data in a GIS and daily incremental updates.
- Degree of standardization possible in the interface now and in the future.
- Deployment of the interface: Where do the interface elements run? Who runs it? How automated is the interface? How to use it to initialize the OMS model.

Examples from a variety of projects illustrate the discussion points and highlight different approaches.

BACKGROUND

This paper presents our experiences working on the interface between GIS and OMS using a variety of best-of-breed products. We hope that utility staff considering doing an interface can learn from this. Those who have done this already can use this paper as a gauge to see if their experience is typical.

Our experience is presented as a story representing an amalgamation of our project experience. The story poses the question: “A standard interface is desirable, but is it possible?”.

In this story, an electrical distribution utility is using a best-of-breed approach. They understand the need for a GIS to be the repository of distribution data but a separate system oriented to real-time performance is required for outage management. To piggy-back on the business benefits of the OMS, they have proceeded with the selection and configuration of the GIS. They are just starting to populate it. They have a short list of OMS vendors and have almost finished writing the RFP. They are working on writing the specifications for the interfaces.

THE STORY

The story begins by joining the project team in a status meeting on the OMS project. Attending the meeting are the PM, the Project Manager, MrC, a consultant, and TL, the Technical Lead for the project.

PM asks about the status of the GIS:OMS interface: “We’ve done a lot of work on the functional requirements for the OMS, now let’s get down to wrapping up the requirements for the GIS:OMS interface. First thing, one of my dumb questions.”

The team members brace themselves for the dumb question. They remembered the dumb question from six months ago, “Why do we need a separate system for running OMS, why not use the GIS?”. That question stirred up hours of discussion and white-board sketches...

PM: “If we buy the OMS from our GIS vendor, shouldn’t that eliminate the need for the GIS-OMS interface?”

MrC: “The GIS and OMS are two different systems with different functionality, data requirements and data quality. Whether you get it from the same vendor or go for the best-of-breed approach, you will have to map the GIS and OMS data and transfer the data between two systems. Also, major OMS vendors offer pre-packaged integration solutions to extract the data from various GIS packages.

PM: “OK, back to the requirements.”

MrC interjects: “By the way, there is some standardization activity going on in this space such as: GML file formats from OpenGIS; data models such as MultiSpeak and the Common Information Model (CIM) from IEC TG57 WG14; and standard transport mechanisms such as SOAP.”

PM: “Right, so make sure we ask for standard approaches. I want this to be as close to plug & play as possible. This shouldn’t be too hard. TL, can you get this done by the next meeting?”

Requirements On A GIS:OMS Interface

TL starts by gathering requirements in the Control Room by interviewing DO, Distribution Operator. TL wants to determine the data required in the OMS and its use to get requirements on the interface.

TL: "So DO, the OMS is only as good as long as the data matches what is out in the field. We are looking for your requirements on the interface that brings the data in from the GIS."

DO: "As usual, I don't want anything too fancy. Just **make sure the OMS matches the field in real time**."

TL: "So you want to bring in the as-built changes as soon as they are ready?"

DO: "Yes, but I don't want to wait that long. It doesn't have to be pretty, but I want the connectivity in place as we are energizing the line. When the as-builts come in, that will be too late because I won't be operating that area anymore. I'm thinking before they start a job we have the proposed changes ready to go in OMS."

TL: "OK, so you need to bring in the proposed work. Later on, the as-builts can come in and pretty-up the graphics. Is there anything else you need from the GIS?"

MrC: "We have a requirement for **bringing in changes as a work order**."

DO: "I've seen some sample plots from GIS. The first thing I noticed, is there are no elbows shown. They explained they are implied and just clutter up the database. I need those elbows in OMS. If the Field can operate them, I need to operate them in OMS so that OMS matches the field."

MrC interjects: "That's not a problem. The interface should be able to generate implied devices like load break elbows."

TL: "And also bypass switches on reclosers. OK, that sounds like a requirement."

MrC: "Yes, call it **overcome model impedance mismatch**."

TL: "Yah, right."

DO: "Other than that, I like how the GIS plots look. For example, in the areas where there is a lot of plant, they've got a blow-up of the details. If they look the same in OMS, I'm happy."

MrC: "That is a tricky topic. Some GISs can maintain multiple representations. Yours provides only one. What they've done is used smaller symbols in congested areas but on the plots provide a blow-up. If the tiny symbols can go into the OMS, you can always zoom in to see the details. So you've got a requirement to **preserve the cartographic aspects like symbol scale and annotation**."

DO: "I can see that being useful for our stations. They are really congested. Let's have a look at this plot to see what they did. I don't see any! Just a symbol indicating the whole station! That's odd, because we've got schematics in the Control Room"

TL: "Those are CAD files. Must have been out-of-scope for the GIS project."

DO: "Out-of-scope for them, not for us! If we get a bus outage, I want to enter that into the OMS so we get proper grouping of incidents to the bus, not to each of the feeder breakers. There's a requirement for you, we need station details."

MrC adds to the list: "**Interface needs to bring in station details** from CAD files."

MrC changes the topic: “On a technical note, the OMS achieves its high performance by only showing part of the electrical network. They do this by tiling the geography or by dealing with one feeder at a time. The GIS is a seamless map, so the **interface has to extract tiles or feeders**.”

DO: “Just make sure the connectivity is right. The GIS plot looks pretty, but the feeder better be connected and energized in OMS.”

MrC: “DO makes a good point. OMSs typically need special modeling items such as a node to represent the source of supply and a means of connecting up transformers to customers. It also may need special attributes such as an Operating Zone on a device. We can check with the GIS team on this.”

TL continues on by interviewing GISguy, the Technical Lead of the GIS project.

GISguy: “OK, let’s talk. But we’ve just been through three rounds of revisions to the data model, so we can do whatever you like as long as it doesn’t involve anymore changes.”

TL: “Well, my first question is how standard is the GIS?”

GISguy: “It’s definitely standard. We are using a COTS… sorry, another acronym. We are using a Commercial Off The Shelf GIS product and we are using a public domain data model. We are fortunate that we were not the first utility to do this.”

TL: “What about the three rounds of revision?”

GISguy: “Well, we started with the standard model but have tweaked it to use our terminology and nomenclature and get rid of attributes we don’t need so we don’t clutter up the database.”

TL: “DO said he’d like elbows.”

GISguy” “I’m serious about no more changes, we went through this and we are not adding elbows.”

TL: “No problem, I was just testing you. We can get elbows as well as recloser bypass switches generated by the interface.”

TL continues: “DO also said he’d like the updates to come in as work orders.”

GISguy: “That won’t be a problem, our day-to-day work will be work orders. However, I do have a backlog of updates to transformer attributes. We didn’t get an attribute correctly populated on the first pass for one area. These are all over the place. We could probably batch them up as a work order.”

TL: “OK, the **interface must process changes as work orders**.”

MrC: “What about the modeling items needed by OMS?”

GISguy: “We relate source objects to breakers and reclosers. We need these to do QA/QC tests after we’ve done edits.”

TL: “That’s good because DO wants his **feeders properly connected and energized**.”

MrC: “What about the Operating Zone and district name attribute on devices?”

GISguy: “I’m not adding any more attributes. We’ve got the Operating Zone as well as county and district polygons. That should be good enough. I don’t want to store any additional attributes that can be retrieved using a spatial query”

MrC: “Another requirement then, the **interface needs to do some spatial queries to synthesize attributes**.”

GISguy: “By the way, we have a lot of data. In fact, we‘ve decided to partition it up into multiple datasets: one for the landbase, one for distribution, one for subtransmission, and one for transmission. Moreover, I’m thinking of storing the landbase data on a different server.”

MrC: “The requirement is for the **interface to extract from multiple datasets possibly residing on multiple data servers**.”

GISguy: “I should also mention that we are finding lots of issues when we run QA. We are making massive systematic changes to the data. Don’t expect me to package these up as work orders!”

MrC: “This is to be expected. Will this occur after going live? If so, we will need a requirement for large scale changes or a **full model extract and rebuild**.”

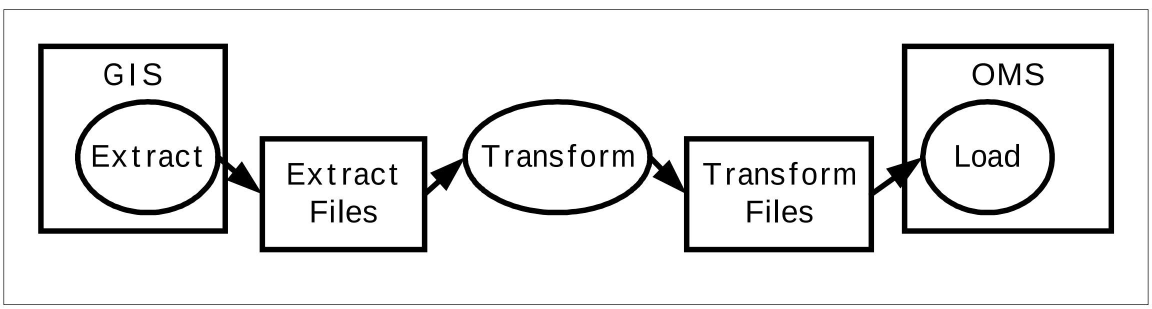
Elements of the Interface

Later, TL and MrC have a discussion about how these things work. MrC’s explanation summarizes the various approaches.

TL: “I’m getting a good handle on the requirements, but what does the interface actually look like?”

MrC: “The GIS:OMS interface is pretty complex. It has to be as sophisticated and flexible as the GIS on the one end, do some transformation to translate the GIS data into the OMS data model, and load up the OMS.”

“This is a classic ‘ETL’: Extract, Transform, and Load. Let me sketch this out.”



TL: “Not to mess up your sketch, but where are those CAD files holding the station schematics?”

MrC: “You are right, I don’t want to mess up the diagram. Consider the them as another set of extract files.”

MrC continues to lecture: “I think you are going to find the Extract piece is a GIS application program producing output in a standard format. This standard format for now could be a vendor neutral formatted suggested by the OMS vendor or WG14 or

MultiSpeak XML schema-based standard output. You'll notice it is files. The large volume of data moving across the interface makes files appropriate."

"The Transform is another process that knows about GIS features and OMS features. It is the program that generates the implied devices and correctly populates the restricted set of attributes of interest to the OMS from the available GIS feature attributes. The OMS vendors typically provide either a standard model to map into or allow you to configure the model as you like. The Transform program produces output in a standard format."

"The OMS model is usually built based on the node and connecting branches, a true representations of the electrical network. If your GIS data model is not based on node and branch or uses 'simple' and 'complex' branches, then the transform process converts the model to nodes and branches."

TL: "I spotted some switchgear on the GIS plot that I know is more complicated than it looks. On the plot, it is one symbol."

MrC: "Right, the OMS requires more information than the one node. It needs all the essential components within the switch box."

TL: "What about our customer connections?"

MrC: "If your GIS data model does not have a transformer to customer relationship then we have to obtain it from the CIS data source. The transform process will establish this relationship before importing the data in the OMS."

"The Load program brings the data into the OMS and controls when the changes become 'live'."

TL(shocked): "I don't recall seeing any of these programs in the literature from the OMS vendors, they just state that they interface to every GIS."

MrC: "The Extract piece is specific to the GIS, the Load program is specific to the OMS but the Transform program can be separate or bundled with the Extract or Load programs. Different vendors approach it in different ways. In the future, when the standard distribution model is defined by the WG14, the GIS should be able to export the data using a standards based XML schema. The OMS could then use the exported data to build the OMS model. "

Performance Considerations

TL and MrC next talk about performance.

TL: "The GIS team has started loading data and the server has been busy all weekend. I've been thinking about this. There is so much data in the GIS, the interface is going to run like a pig."

MrC: "Well, remember that the changes to GIS are going to be Work Orders. The **Extract tool needs to detect changes** and **it should only pull out the changed tiles or feeders**. Also, the OMS typically doesn't store as much detail as the GIS. The **interface should only extract the essential information** it needs."

TL: "Yes, that will help. We only make changes to the GIS as fast as the field builds them. But why not just move the individual feature changes across?"

MrC: "In general, this is a tricky problem. Some GISs don't provide a good way of capturing the individual changes. Others do but the order of inserts, deletes, and updates to the connectivity model is crucial. It is more robust to avoid the problem by extracting an entire feeder or tile."

TL: "Speaking of tiles, what about the landbase? We get wholesale refreshes every six months."

MrC: "Landbase information in an OMS is typically pretty lean. Again, we'll want the **interface to only take essential features and attributes from the landbase**."

TL: "I'm still worried about the performance. The GIS dataset is gigabytes in size!"

MrC: "To deal with really big volumes, we'll want to **run multiple instances of the interface in parallel**."

Degree of Standardization Possible

TL has his material ready for the next status meeting.

PM: "How are the requirements on the GIS:OMS interface coming?"

TL: "Although the interface is more complicated than I first thought, I think we have a good set."

PM: "What do you mean complicated? I want plug & play."

TL: "First, our GIS data model is not standard because its been reconfigured for our utility. Secondly, each of the OMS vendors has their own proprietary data models that we need to match."

MrC: "Of course the OMS vendors are offering the data model loosely based on the CIM or CIM extensions but the WG14 standard model is not finalized so our aim is to keep the data model as close as possible to the CIM recommended model."

TL: "If we were doing this in a few years, we would probably be using a CIM-compliant GIS data model that could be directly used by a CIM-compliant OMS. However, we would still need an interface smart enough to move across only the changes to the GIS data."

MrC: "It's not as bad as it used to be. These used to be custom software interfaces. Now there are products to help with the interface that can be configured rather than written from scratch each time."

PM: "I guess I don't get plug & play. Well, we need to make progress today, so we will have to live with a significant interface. TL, meet with the team and figure out how to deploy the interface and what it takes to sustain it. By the way, what happens when we upgrade the GIS application or if we change the GIS vendor?

MrC "They are two different scenarios. If you upgrade the GIS application version without changing the GIS data model then the OMS vendor could provide an extract tool compatible with the new version, but if you change the data model and rename existing devices or add completely new devices then the GIS-OMS data mapping needs to be updated."

"In the future, if you change the GIS vendor but keep the same data model then the OMS vendor should provide a tool to extract the data from the new GIS system. The transform and OMS data model will not be affected. This will provide you plug and play approach even though standards are not published yet. Once WG14 publishes the standards and all vendors support it will be even easier to cope with this because they all will talk in the same language."

Deployment of the Interface

TL and MrC talk about the requirements for deploying the interface.

TL: "We've talked about where the interface programs will likely run. But who runs it? How automated can it be?"

MrC: "The GIS team is intending to use a work order process for their day-to-day work. However, they also said they will be being doing attribute updates on a large group of devices. They can run the Extract portion of the interface after they finish a work order. Some utilities **run the Extract program periodically**, say in the evening after the drafters are finished for the day. The Extract tool produces log files that should be inspected for errors."

"The Transform program functionality is usually incorporated in either the Extract and Load programs or both."

"The **Load program can be run manually** on the OMS or some places **automate it** to run after the Extract is finished. Your OMS Data Maintainer should be running this and checking the log files to make sure it is successful."

TL: "What is all this checking of log files for? Once the interface is debugged and working, shouldn't it work without any intervention?"

MrC: "There is a funny thing about computer systems using different data models. Data that is apparently good in one system may not work in another system. Even within the GIS, the data may look good but the Extraction tool exercises different aspects of the data and my find connectivity problems."

TL: "Sounds like we need two kinds of people to staff this: a GIS guy who can decode log files and an OMS technical person to run the Load program."

MrC: "You don't necessarily need two people to run the entire process. What works well is to have a **Data Model Administrator skilled in using the GIS and the OMS**. They don't have to know how to edit data in the GIS, just use it to locate features. It is a technical role that you can wrap with your management processes."

At the next status meeting, the team concludes the specifications of the interface.

PM: "So TL, what is this GIS:OMS interface going to take to sustain?"

TL: "We think we'll need a technical role to run the interface and resolve data issues. I'll be estimating the exact number of GIS editors based on the degree of changes to the GIS."

PM: "I didn't think we'd get away without a resource here. Thanks for your good work. What's next?"

The requirements developed by the Project Team help to distinguish between the leading OMS vendors. After selecting an OMS vendor, they patiently work through the extreme detail required to configure and test the interface. They end up with a smoothly functioning GIS:OMS interface. They spend an appallingly long time messing around resolving data quality issues. However, eventually the data is good enough for OMS *production and the enhanced quality of data in the GIS provides benefits for others in the utility. Everyone lives happily ever after.*

CONCLUSION

The GIS:OMS interface keeps the OMS up-to-date by bring in changes packaged as work orders based on the long-transactions of GIS work orders. For performance reasons, the interface brings across feeders or spatial tiles that correspond to changes in the GIS. The interface runs automatically to capture daily changes or can be run manually.

The interface consists of an Extract tool running on the GIS, a Transform tool to map GIS features and attributes to their equivalent in the OMS, and a Load tool running on the OMS to bring the changes into the OMS. The complexity of this interface depends on the degree of standard data models and transportation mechanisms used to interface GIS and OMS. In the past, interfacing best-of-breed systems required custom software. Now, pre-packaged, configurable tools can be used.

The standard GIS and OMS data model and data flows are still being defined by the various standards groups. Once the standards are published and widely accepted by the users community the interface should be able to make use of them. There always will be some degree of model mismatch between the standards data model and a utility's selected data model. This could be overcome by providing various extensions to the standard data model. The data mapping, a process of logically matching applications objects and attributes to determine the data flow, will not be replaced whether the interface is custom, configurable or standards based.

The paper clearly demonstrates that a standard interface is not a silver bullet that will cure all problems. A Utility still has to diligently define the data model to meet end users' expectations and ensure that appropriate data is mapped and transferred between the GIS and OMS preserving the data integrity of each system. This enables the systems to connect yet still preserves the autonomy of each system.

REFERENCES

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